

## **APPENDIX A**

# **ShinEtsu**

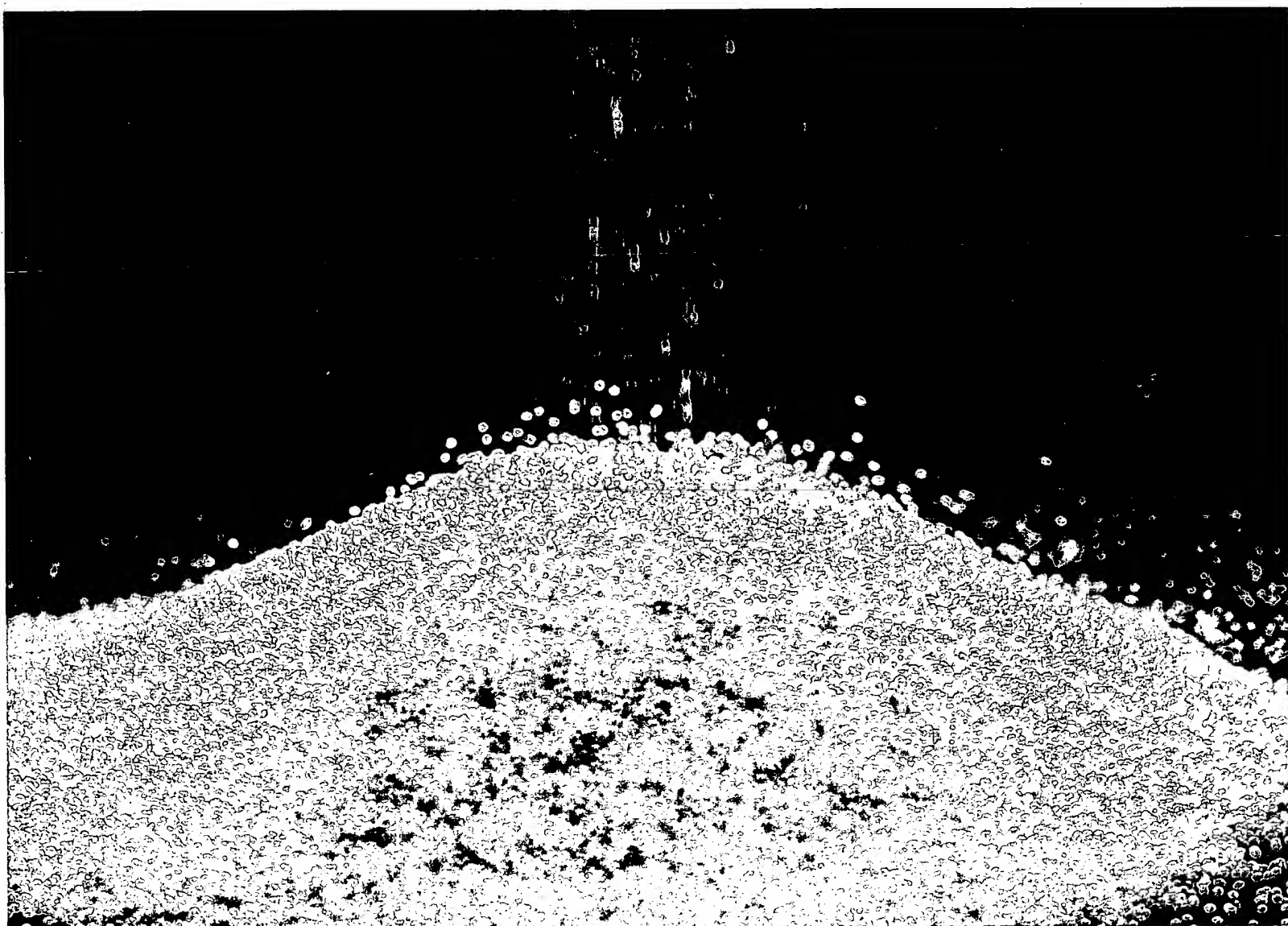
NF

Low-Substituted Hydroxypropyl Cellulose

# **L-HPC**

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Disintegrant-Binder



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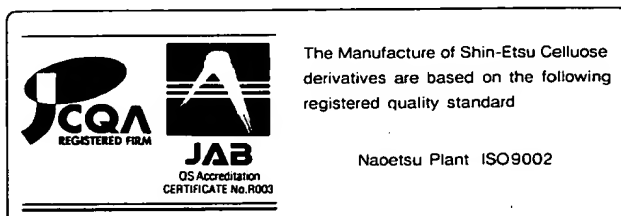
## PREFACE

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L-HPC (Low-Substituted Hydroxypropyl Cellulose) is a low-substituted hydroxypropyl ether of cellulose in which quite a small proportion of the three hydroxyl groups contained in the  $\beta$ -o-glucopyranosyl ring of the cellulose is etherified with propylene oxide. While a highly substituted (MS = 3 to 4.5) hydroxypropyl ether of cellulose is soluble in both water and alcohols, L-HPC is insoluble in these solvents but it swells in water. Moreover, modifications of the substituent content and particle size of L-HPC cause changes in the binding and the disintegrating characteristics as a result of subtle changes in physical properties. Therefore, we are manufacturing several types of L-HPC with different substituent contents and average particle sizes in order to allow the selection of the most suitable one for each type of application.

Shin-Etsu Chemical has carried out extensive research on the synthesis of numerous cellulose derivatives as well as on their application as pharmaceutical excipients. L-HPC, which has unique characteristics as a disintegrant and binder, is a product of this research and development program.

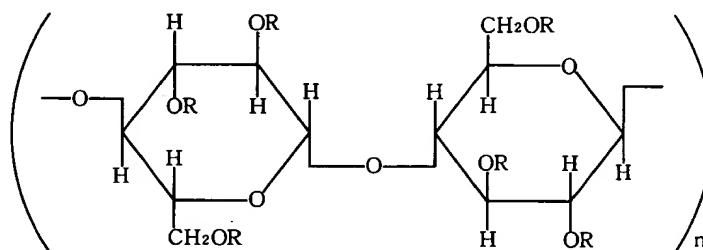
Since L-HPC was brought onto the market, its effectiveness has been confirmed by many researchers in the field of pharmaceutical technology. It was admitted to the JP XI in 1986 and also to the NF in 1990. L-HPC is manufactured in a plant controlled according to the good manufacturing practice (GMP) guidelines, and is subjected to thorough quality control testing. Furthermore, the pharmaceutical research group of Shin-Etsu Chemical is always working to improve the product, and to extend its range of applications. Technical advice is available on the suitability of L-HPC for specific applications. We are confident that L-HPC will be a widely useful, pharmaceutical material, offering a simplified preparation composition, an improvement in drug bioavailability and a highly stable drug formulation.



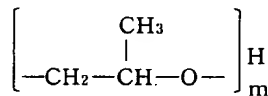
# DESIGNATION AND STRUCTURAL FORMULA OF L-HPC

<b>Designation</b>	Low-Substituted Hydroxypropyl Cellulose (L-HPC)
<b>Admissions to compendia</b>	NF, JP
<b>Chemical name</b>	Cellulose, 2-hydroxypropyl ether (low-substituted) (CAS 9004-64-2)
<b>Trade name</b>	L-HPC

## Structural formula



R = H or

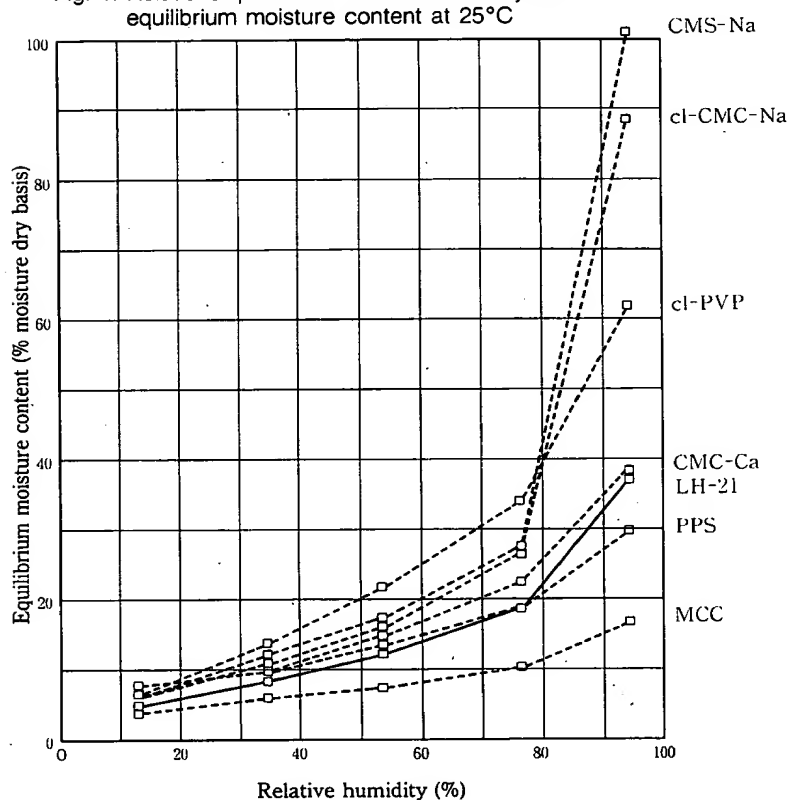


# PHYSICO-CHEMICAL PROPERTIES OF L-HPC

- 1) Real specific gravity .....1.46
- 2) Apparent density .....0.45~0.70 g/mL(tapped)  
(differs by type)
- 3) Equilibrium moisture content .....

The relationship between relative humidity and equilibrium moisture content of L-HPC, various disintegrants and microcrystalline cellulose is shown in Fig. 1. The data for LH-21, a representative type of L-HPC, are shown; other types, of L-HPC show similar relationships.

Fig. 1: Relationship between relative humidity and equilibrium moisture content at 25°C



Abbreviations are as follows

CMS-Na	Sodium carboxymethyl starch
cl-CMC-Na	Cross-linked sodium carboxymethylcellulose
cl-PVP	Cross-linked polyvinylpyrrolidone
CMC-Ca	Calcium carboxymethylcellulose
PPS	Partly pregelatinized starch
MCC	Microcrystalline cellulose

#### 4) Solubility

L-HPC does not dissolve in water but swells. It neither dissolves nor swells in ordinary organic solvents, but dissolves in a 10% NaOH solution to give a viscous solution.

Table 1: Solubility of L-HPC

Solvent	Solvent required to dissolve 1 g of L-HPC	State
10% NaOH soln.	9mL	Viscous solution
10% Na <sub>2</sub> CO <sub>3</sub> soln.	More than 10,000 mL	Swollen
Water		
2 N HCl		Insoluble
Ethanol		
Ethyl ether		

#### 5) Types of L-HPC and their powder properties

As shown in Table 2, the types of L-HPC comprise various combinations of average particle size and hydroxypropoxyl content.

Table 2: Types of L-HPC

	low ————— Hydroxypropoxyl content ————— high		
Particle size fine — coarse		LH-11	
	LH-22	LH-21	LH-20
	LH-32	LH-31	LH-30

Typical powder properties of the seven types of L-HPC currently available are shown in Table 3.

Table 3: Powder properties of each type of L-HPC

Type		LH-11	LH-21	LH-31	LH-22	LH-32	LH-20	LH-30
Bulk density	Loose	0.34	0.40	0.30	0.37	0.21	0.36	0.25
	Tapped	0.57	0.65	0.59	0.63	0.49	0.65	0.51
Angle of repose	degrees	49	45	49	48	53	48	51
Average particle size	μm*	50	40	25	40	25	40	25

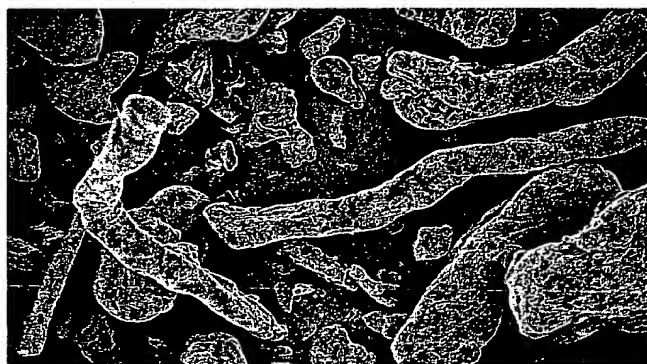
\*Expressed as the values extrapolated on Rosin Rammler chart for the particle size distribution, which was obtained by sieving using a Ro-tap testing sieve apparatus.

## 6) Electron micrographs

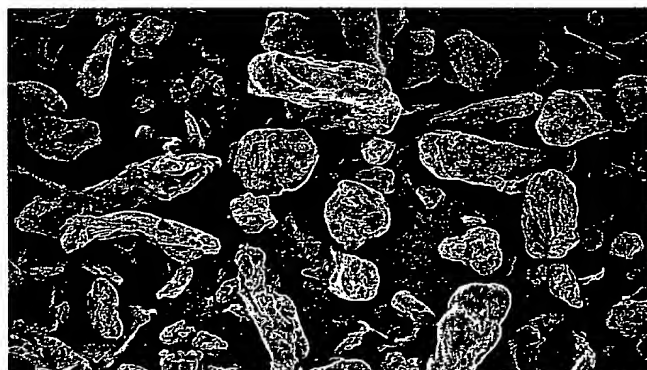
LH-11



LH-21



LH-31



10μm

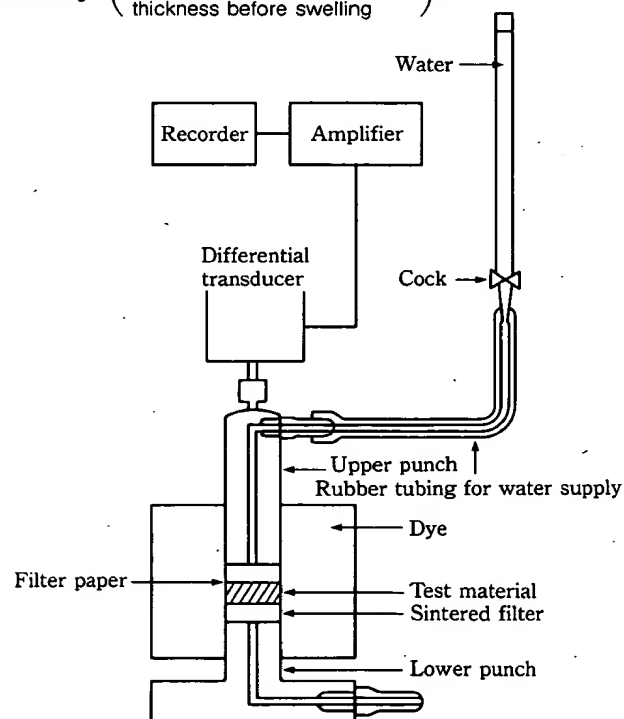
## 7) Swelling properties

The swelling properties of L-HPC, as a measure of its disintegrant ability, were measured using the equipment illustrated in Fig. 2. In general, the swelling properties of a disintegrant depend on the nature of the drug, the diluting substance, the binder, etc. In this experiment the swelling was measured by compressing tablets composed of alumina, which does not swell in water, as a base. The upper punch was then replaced immediately with a punch fitted with a water supply tube. The results of a comparison of the swelling properties between L-HPC and various disintegrants and binders as well as swelling of the various types of L-HPC are presented below.

Composition of tablet and conditions of tableting		
Composition .....	Disintegrant or binder	100 mg
	Alumina	400 mg
	Total	500 mg/tablet
Tableting pressure .....		55MPa
Tablet shape .....		15 mmφ flat

Fig. 2: Apparatus for measuring degree of swelling

$$\text{Degree of swelling} = \left( \frac{\text{thickness after swelling}}{\text{thickness before swelling}} - 1 \right) \times 100$$





a) Swelling properties of L-HPC and various disintegrants and binders

Fig. 3 shows the swelling properties of L-HPC and various disintegrants and binders. Swelling of L-HPC reaches saturation in a short time, and L-HPC is considered to be readily wettable. Moreover, among those disintegrants for which swelling reaches saturation within 60 seconds, L-HPC exhibits the greatest degree of swelling.

b) Types of L-HPC and their swelling properties

Fig. 4 illustrates the swelling properties of the various types of L-HPC.

The relationship between average particle size and degree of swelling of L-HPC after 60 seconds, is shown in Fig. 5. The types with a larger average particle size have a higher degree of swelling. In addition, as regards the relationship between the hydroxypropoxyl content and the degree of swelling, LH-20 and LH-30 with a high hydroxypropoxyl content tend to need a longer time for the swelling to reach saturation compared with the other types. Comparisons of the degree of swelling between LH-21 and LH-22 or between LH-31 and LH-32 demonstrate that LH-21 and LH-31 with a higher hydroxypropoxyl content show higher degrees of swelling, respectively.

Fig. 3: Swelling properties of L-HPC and various disintegrants and binders

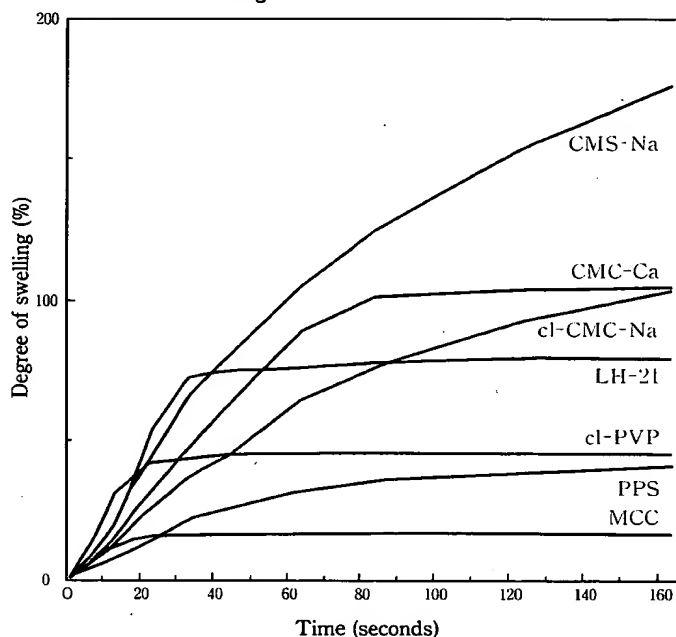
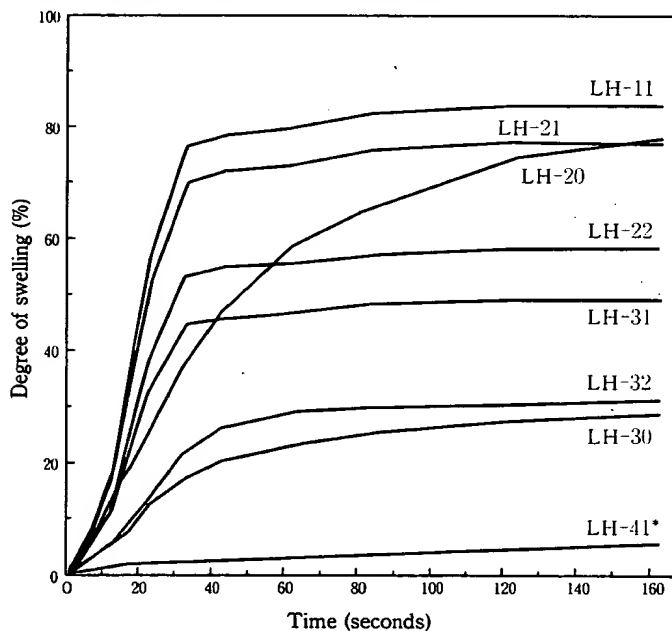
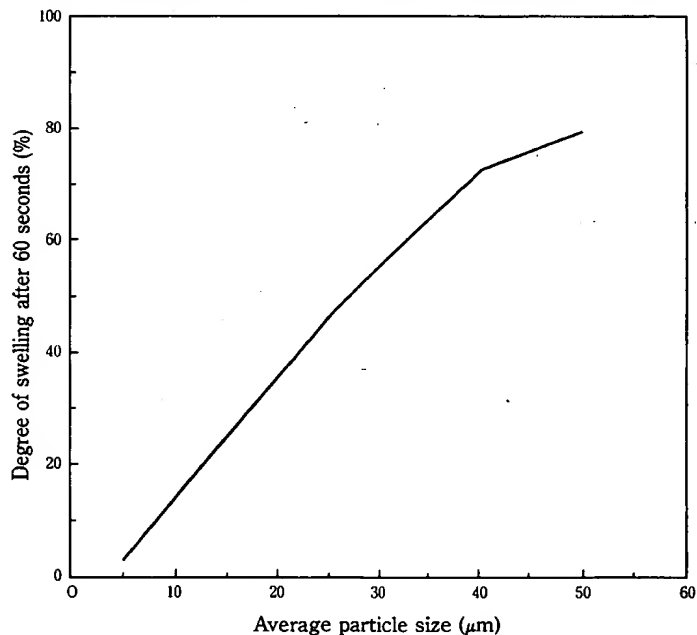


Fig. 4: Swelling properties of various types of L-HPC



\*Trial product (L-HPC ultrafine particles)

Fig. 5: Average particle size and degree of swelling of L-HPC



# BASIC CHARACTERISTICS OF PREPARATIONS CONTAINING L-HPC

## 1) Disintegration and binding characteristics

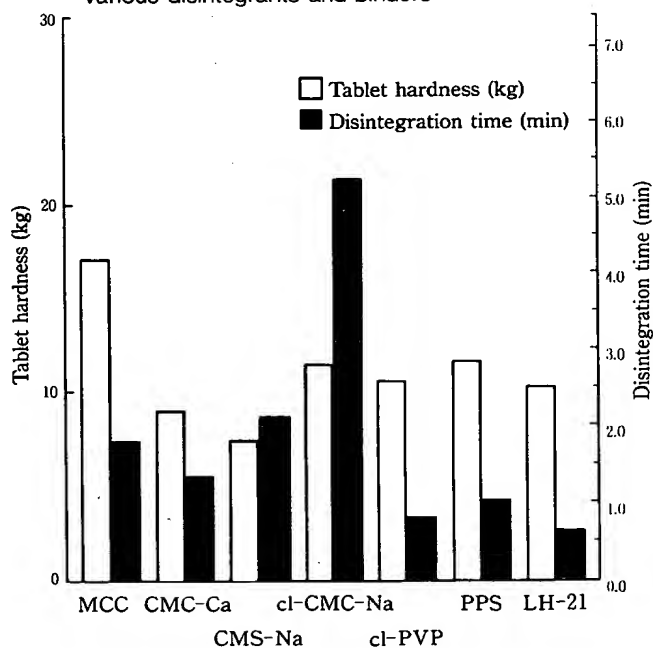
L-HPC has a binding ability as well as a swelling characteristic as a disintegrant. In order to evaluate the disintegration and binding characteristics, a tableting test using spray-dried lactose as a base was performed. The disintegration time and the tablet hardness of L-HPC and various disintegrants and binders were compared. Furthermore, the characteristics of different types of L-HPC were also comparatively studied. The results are presented below.

### a) Comparison of disintegration time and tablet hardness between L-HPC and various disintegrants and binders

The disintegration time and tablet hardness of L-HPC (represented by LH-21) and various disintegrants and binders are shown in Fig. 6. L-HPC has a shorter disintegration time than the other disintegrants and binders, and the tablet hardness of L-HPC was the fourth highest suggesting that this base has a good combination of disintegration and binding properties.

Test methods		
Tablet composition	Spray-dried lactose*	159.2 mg
	Binder or disintegrant	39.8 mg
	Magnesium stearate	1.0 mg
	Total	200.0 mg/tablet
		(*: Fast-Flo lactose)
Preparation	Spray-dried lactose	Binder or disintegrant
	Mixing (5 L V-blender, 20 min)	
	Magnesium stearate	
	Mixing (5 L V-blender, 2 min)	
	Tableting (Rotary tableting machine, HT-P18)	
	Rotational speed: 30 min <sup>-1</sup>	
	Punch: 8 mmφ, 6.5 mmR	
	Tableting pressure: 1st pressure : 59 MPa	
	2nd pressure : 195 MPa	
Measurement	Tablet hardness	Erweka hardness tester
	Disintegration time	USP disintegration test

Fig. 6: Disintegration time and tablet hardness of L-HPC and various disintegrants and binders



b) Comparison of disintegration time and tablet hardness between types of L-HPC

The disintegration time and the tablet hardness of various types of L-HPC are shown in Fig. 7. There is a tendency for L-HPC with a larger average particle size to have a shorter disintegration time and for L-HPC with a smaller average particle size to have a higher hardness. The relationships among the average particle size, disintegration time and tablet hardness of L-HPC are presented in Fig. 8. In this experiment, L-HPC containing 10.0 ~ 12.9% hydroxypropoxyl content was used.

Fig. 7: Comparison of disintegration time and tablet hardness of different types of L-HPC

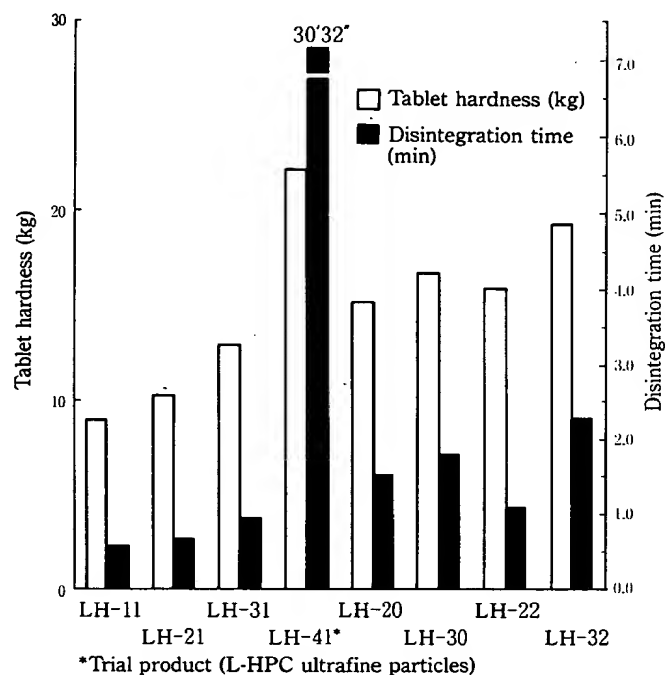
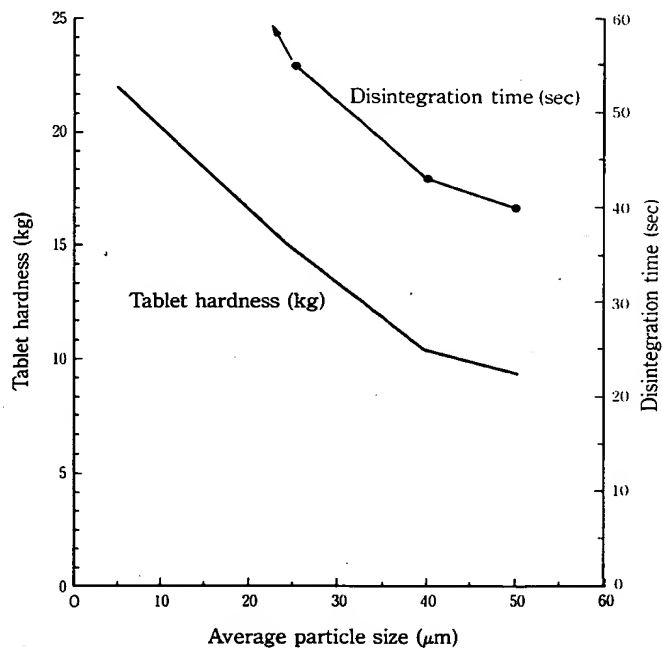


Fig. 8: Dependence of the disintegration time and tablet hardness of compressed tablets, on the average particle size of L-HPC



c) Comparison of tablet stability between L-HPC and various disintegrants and binders

The tablet prepared in a) were allowed to stand at 50°C, and at 40°C, 75% RH to test the stability of hardness, disintegration time and coloring (YI). L-HPC was a stable excipient with little change in any category. Fig 9 illustrates the changes in tablet hardness, disintegration time and YI during storage at 50°C. Fig. 10 shows the corresponding changes during storage at 40°C, 75% RH. Abbreviations are as given in Fig. 1.

Fig. 9: Changes in tablet hardness, disintegration time and YI during

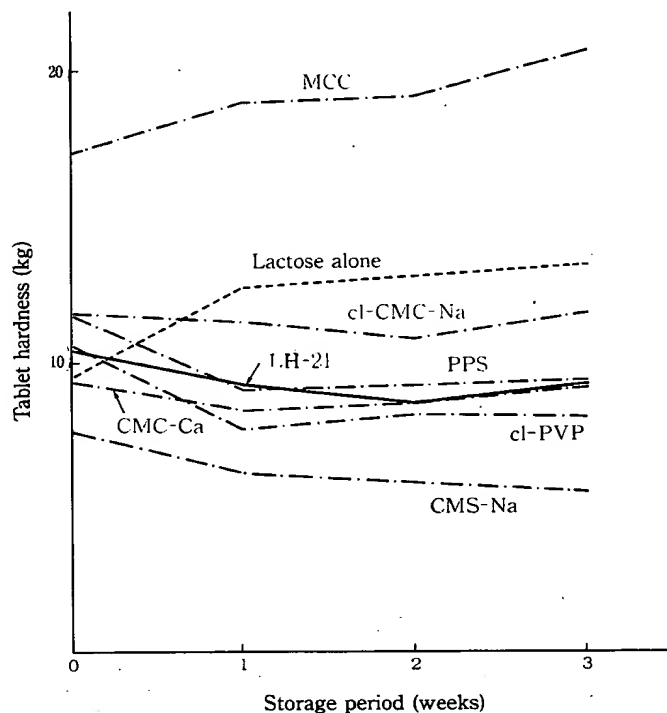
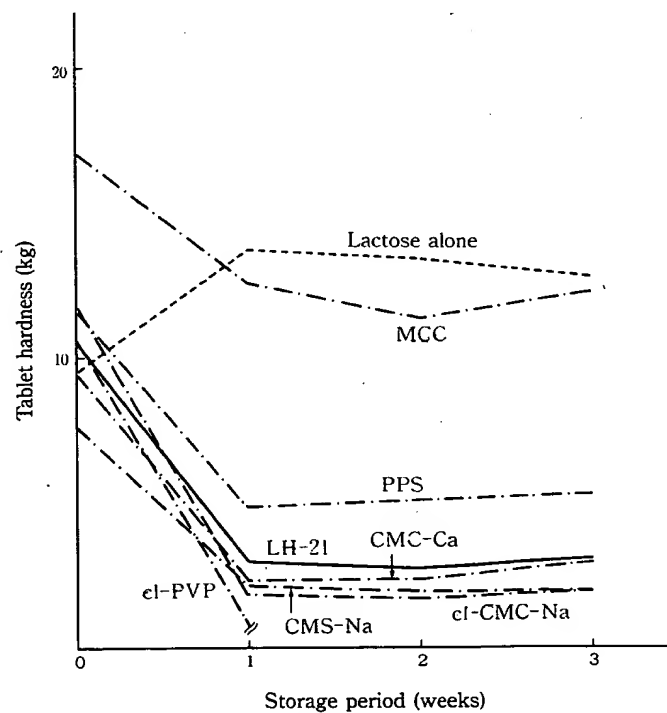
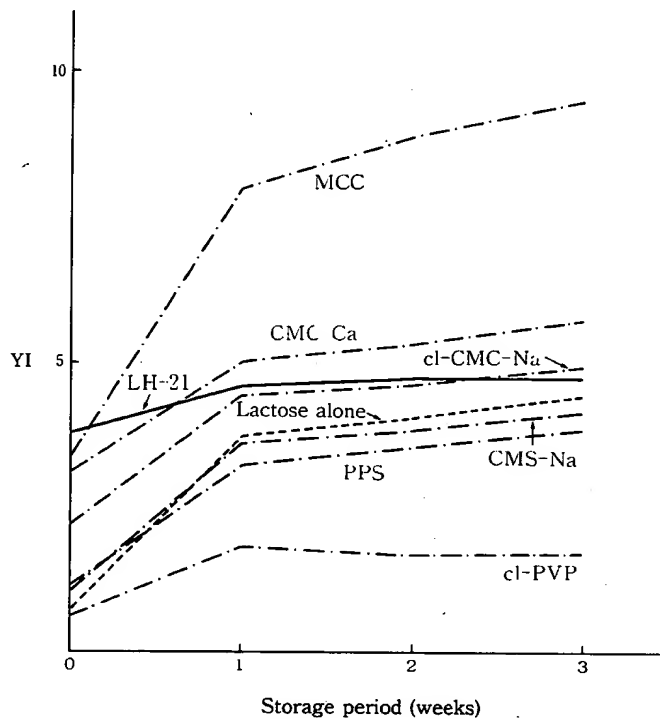
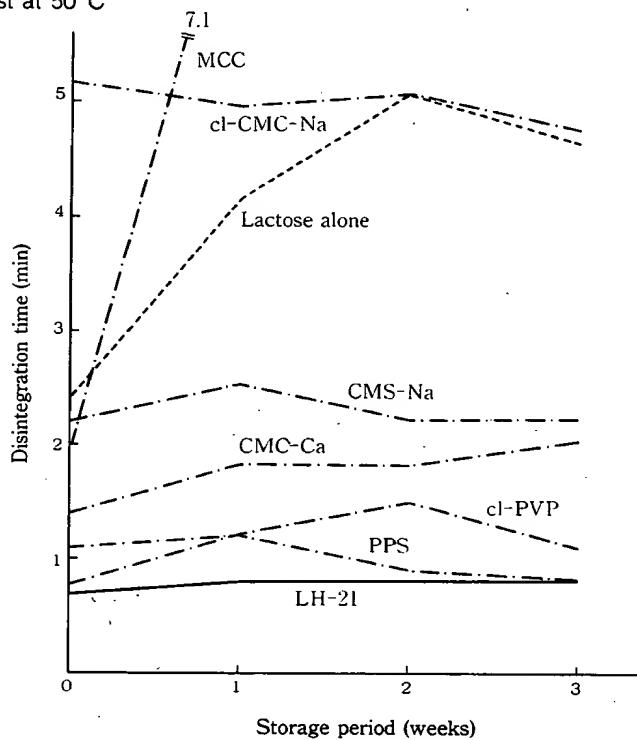


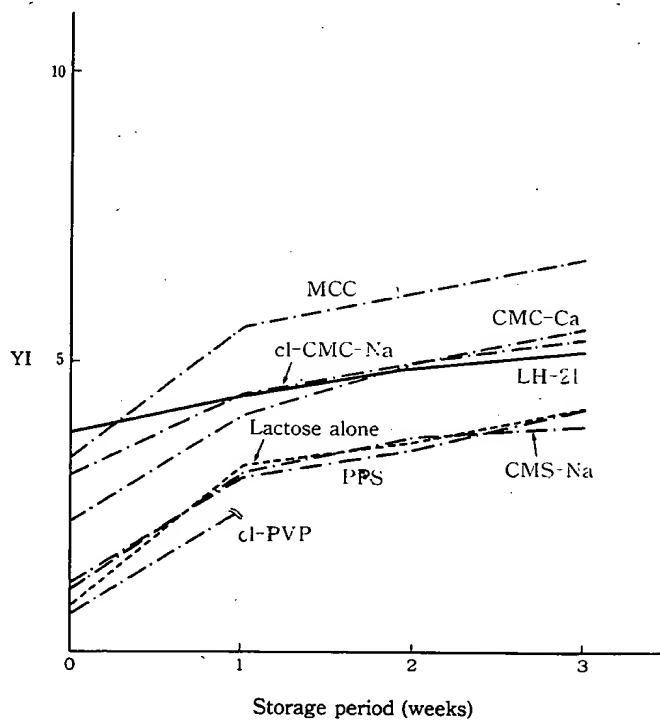
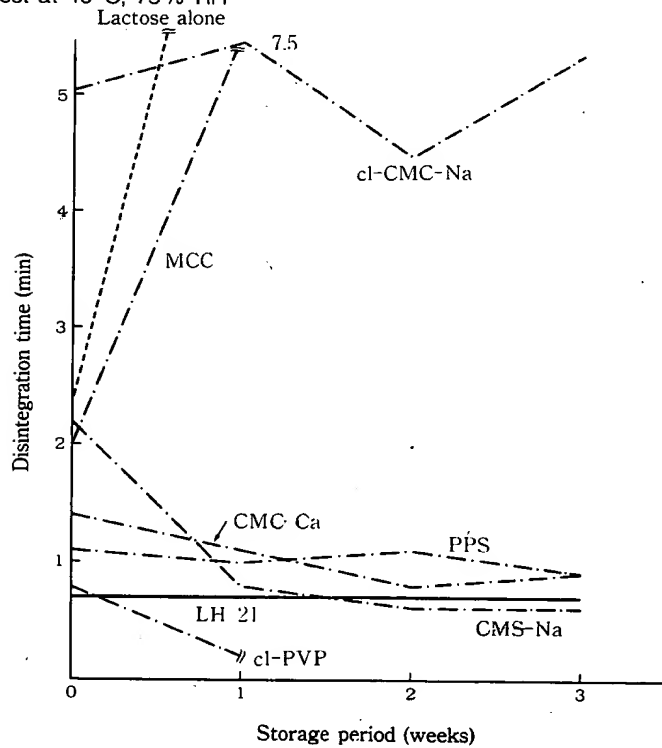
Fig. 10: Changes in tablet hardness, disintegration time and YI during



age test at 50°C



age test at 40°C, 75% RH

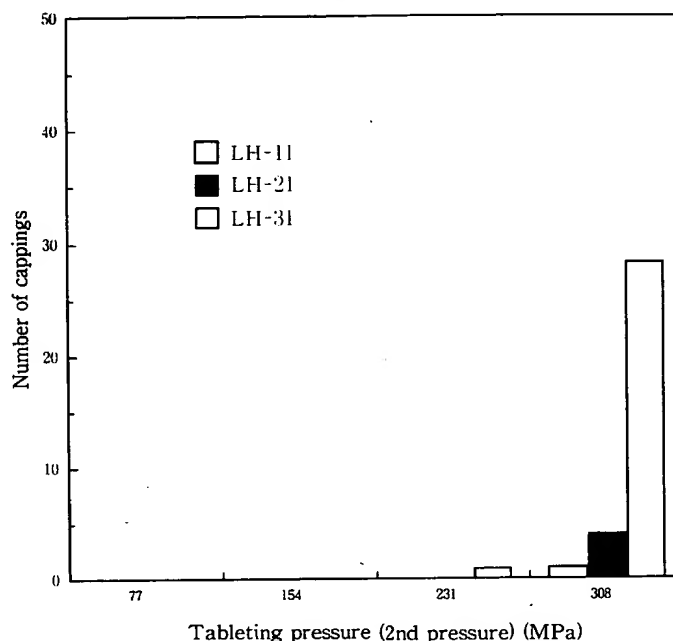


## 2) Ability to prevent capping

L-HPC, particularly LH-11, is a useful excipient to prevent capping during tableting. This is probably because the powder of LH-11 is composed of fibrous particles which form an interlocking network in a tablet. Fig. 11 and Fig. 12 illustrate the dependence of capping occurrence and tablet hardness on the type of L-HPC used.

Test method		
Tablet composition	Phenacetin	84.0 mg
	Lactose	179.2 mg
	L-HPC	14.0 mg
	Magnesium stearate	1.4 mg
	Talc	1.4 mg
	Total	280.0 mg/tablet
Preparation		
	Phenacetin	Lactose L-HPC
	Mixing (10 L Henschel mixer, 20 sec)	
	Water	
	Wet massing (10 L Henschel mixer, 2 min)	
	Granulation (Sieve No. 20)	
	Drying (60°C, Oven)	
	Sieving (Sieve No. 18)	
	Mixture of magnesium stearate and talc	
	Mixing (5 L V-blender)	
	Tableting (Rotary tableting machine HT-P18)	
	Rotational speed: 40 min <sup>-1</sup>	
	Punch: 9 mmφ, 7.5mmR	
Measurement	Capping : Roche Friabilator	
	50 tablets, 25 min <sup>-1</sup> , 30 min	
	Tablet hardness : Erweka hardness tester	

Fig. 11: Relationship between capping occurrence and the type of L-HPC used



### 3) Granulation of kneaded products

Because of its ability to absorb water and to swell, L-HPC can extend the range of allowable amount of water added during the granulation of a non-wettable drug where a moderate kneading state can be obtained.

Fig. 13 shows the relationship between the water content during kneading and the granulation velocity for various types of L-HPC. A type with a higher hydroxypropoxyl content has a higher granulation velocity, though small changes in the granulation velocity due to changes in the water content are apparent. Moreover, a smaller average particle size results in an increase of the granulation velocity.

Test method	
Kneaded product composition	
Phenacetin	90 parts
L-HPC	10 parts
Total	100 parts
Kneading and granulating method	
Phenacetin	L-HPC
Mixing (10 L Henschel mixer, 30 sec)	
Water	
Kneading (10 L Henschel mixer, 3 min)	
Granulation (5" Cylindrical granulator)	
Screen pore diameter: 0.6 mm	

Fig. 12: Relationship between tablet hardness and type of L-HPC used

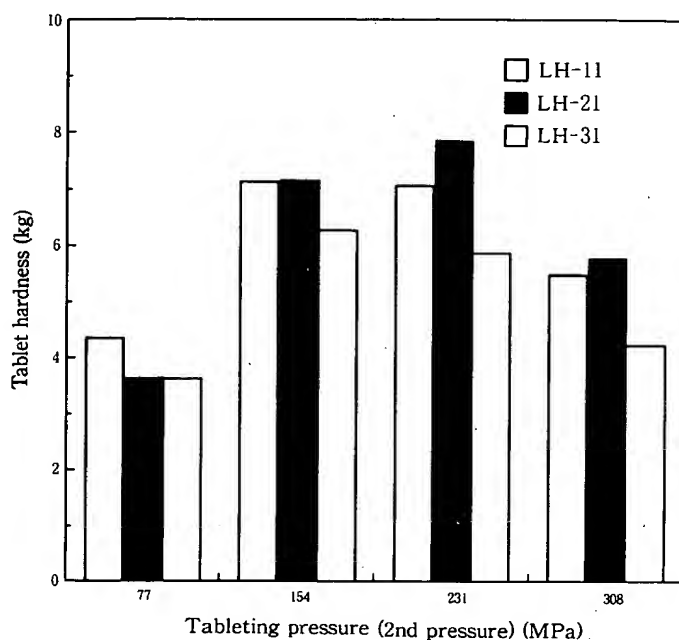
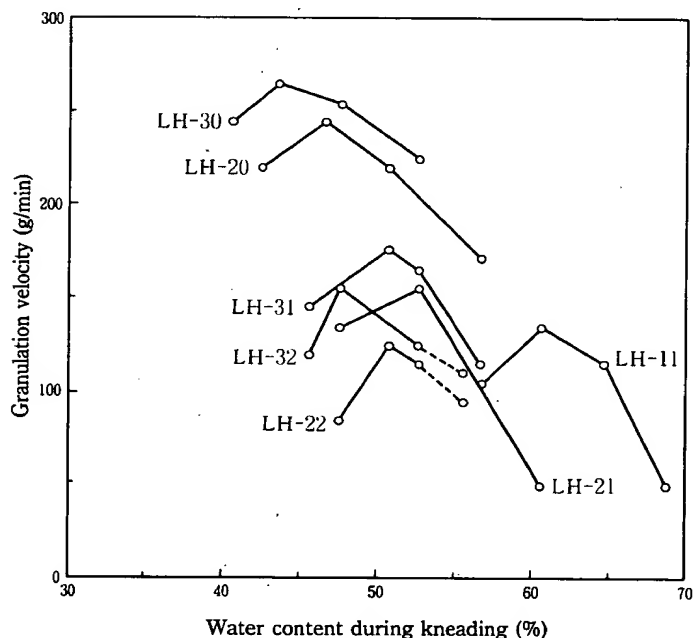


Fig. 13: Relationship of water content during kneading and granulation velocity for various grades of L-HPC



Granulation velocity is given on a dry weight basis.

# SPECIFICATIONS AND TEST METHODS OF L-HPC

The quality specifications for L-HPC are listed in Table 4. L-HPC is an NF Low-Substituted Hydroxypropyl Cellulose. The specifications and test methods are based on the NF monograph. Moreover, the packaging of the products is labeled "For Manufacturing, Processing or Repacking".

Shin-Etsu Chemical performs strict quality control tests to meet GMP regulations, such as the foreign matter tests, the yellowness index test and the microbiological tests.

Table 4: Quality specifications for L-HPC

Item	Type	LH-11	LH-20	LH-21	LH-22	LH-30	LH-31	LH-32	Method
1. Description and Solubility		conforms							USP/NF
2. Identification A: B: C:		conforms							USP/NF
3. pH		5.0 ~ 7.5							JP
4. Loss on drying		not more than 5.0%							USP/NF
5. Residue on ignition		not more than 0.5%							USP/NF
6. Chloride		within the limit (not more than 0.36%)							USP/NF
7. Arsenic		within the limit (not more than 2 ppm)							USP/NF
8. Heavy metals		within the limit (not more than 0.001%)							USP/NF
9. Hydroxypropoxyl content		10.0 ~ 12.9%	13.0 ~ 16.0%	10.0 ~ 12.9%	7.0 ~ 9.9%	13.0 ~ 16.0%	10.0 ~ 12.9%	7.0 ~ 9.9%	USP/NF
10. Particle size		180 $\mu$ m on: not more than 0.5%  150 $\mu$ m pass: not less than 98%	106 $\mu$ m on: not more than 1.0%  75 $\mu$ m pass: not less than 90%			75 $\mu$ m on: not more than 5.0%  45 $\mu$ m pass: not less than 50%			Ro-tap sieve method

\*Items 3, 7 and 10 are not required by the USP/NF monograph, but are tested according to the mentioned methods as Shin-Etsu specifications.

Although great care is taken to avoid any foreign material contamination, it is recommended to sieve the product before usage.



# APPLICATIONS OF L-HPC

## 1) Application to tableting

### a) Tableting by the direct compression method

Multi-vitamin tablets are generally manufactured by the wet granulation method but changing to the direct compression method is expected to reduce the manufacturing cost.

Here, an example of application of the direct compression method to the manufacture of multi-vitamin tablets is shown.

Table 5: Tablet composition

	Active ingredients	Content per tablet	Composition per tablet	Composition of batch
Master batch	1) Vitamin A (dry, stabilized form)	Vitamin A: 5000 IU	2.0 mg	20.0 g
	2) Vitamin AD (dry, stabilized form)	Vitamin D: 400 IU	8.0 mg	80.0 g
	3) Vitamin E (dry, stabilized form)	15 IU	60.0 mg	600.0 g
	4) Folic acid	0.4 mg	0.4 mg	4.0 g
	5) Thiamine nitrate	1.5 mg	1.5 mg	15.0 g
	6) Riboflavin	1.7 mg	1.7 mg	17.0 g
	7) Nicotinic acid	20.0 mg	20.0 mg	200.0 g
	8) Vitamin B <sub>6</sub>	2.0 mg	2.0 mg	20.0 g
	9) Vitamin B <sub>12</sub>	6 µg	0.6 mg*	6.0 g
	Subtotal		96.2 mg	962.0 g
Mixing of tableting	Master Batch		96.2 mg	96.2 g
	10) Vitamin C granules	500 mg	515.0 mg	515.0 g
	11) LH-11		30.6 mg	30.6 g
	12) Spray-dried lactose		249.2 mg	249.2 g
	13) Magnesium stearate		9.0 mg	9.0 g
	Total		900.0 mg/tablet	900.0 g

\*A 100-times-diluted mixture with lactose was used.

# Manufacturing method

## Manufacture of master batch

Drug powder items 3-9  
 Mixing (5 L V-blender, 40 min<sup>-1</sup>, 3 min)  
 Sieving (Sieve No. 25)  
 Mixing (10 L Henschel mixer, 1 min)  
 Sieving (Sieve No. 25)  
 — Drug powder items 1 and 2  
 Mixing (5 L V-blender, 40 min<sup>-1</sup>, 3 min)  
 Sieving (Sieve No. 25)  
 Master batch

## ● Manufacture of tableting powder

Master batch  
 Items 10-12  
 Mixing (5 L V-blender, 40 min<sup>-1</sup>, 3 min)  
 Sieving (Sieve No. 25)  
 Mixing (5 L V-blender, 40 min<sup>-1</sup>, 20 min)  
 — Magnesium stearate  
 Mixing (5 L V-blender, 40 min<sup>-1</sup>, 2 min)  
 Tableting (Rotary tableting machine HT-P18)  
 Rotational speed: 30 min<sup>-1</sup>  
 Punch: Oblong 17.8 mm x 7.8 mm  
 Tableting pressure: 1st pressure: 71MPa  
 2nd pressure: 212MPa

Table 6: Tablet properties

Tablet hardness	19.6 kg
Tablet thickness	5.80 mm
Disintegration time	23 min 16 sec
Friability	0.22%

## ● Measurement:

Tablet hardness: Monsanto hardness tester  
 (measurement in the direction of  
 long diameter)

Tablet thickness: Dial gauge

Disintegration time: Apparatus for USP disintegration test

Friability: Roche Friabilator  
 (20 tablets, 25min<sup>-1</sup>, 4 min)

Multi-vitamin tablets manufactured experimentally by the direct compression method showed properties similar to those of commercially available products.

#### b) Tableting by the wet granulation method

As an application of L-HPC to a preparation with a high drug content, we present an application to tableting by the wet granulation method for acetaminophen. Because of its swelling property in water, L-HPC functions to form granules for tableting without the use of a water-soluble binder paste solution.

Table 7: Tablet composition

	Tablet composition	Composition of batch
Acetaminophen	501.5 mg	858.6 g
LH-11	82.6 mg	141.4 g
Magnesium stearate	2.95 mg	3.3 g
Talc	2.95 mg	3.3 g
Total	590.0 mg/tablet	1006.6 g

Table 8: Tablet characteristics

Tablet hardness	6.1 kg
Disintegration time	22 sec

#### ● Measurement:

Tablet hardness: Erweka hardness tester

Disintegration time: Apparatus for USP disintegration test (37°C, water)

#### Manufacturing method

Acetaminophen      L-HPC

—

Mixing (10 L Henschel mixer, 30 sec)

—

Water

Wet massing (10 L Henschel mixer, 3 min)

Granulation (Sieve No. 18)

Drying (60°C, Oven)

Sieving (Sieve No. 20)

—

Magnesium stearate/Talc = 1/1 mixture powder

Mixing (5 L V-blender, 2 min)

Tableting (Rotary tableting machine, HT-P18)

Rotational speed: 30 min<sup>-1</sup>

Punch: 13 mm  $\phi$  flat

Tableting pressure: 1st pressure: 37MPa

2nd pressure: 111MPa

## 2) Application to granules

In this experiment, L-HPC was applied to prepare granules containing acetaminophen, ethenzamide and caffeine using a cylindrical granulator.

Table 9: Granule composition

	A	B
Acetaminophen	352.0 mg	352.0 mg
Ethenzamide	160.0 mg	160.0 mg
Caffein	48.0 mg	48.0 mg
Lactose	73.5 mg	73.5 mg
Cornstarch	31.5 mg	31.5 mg
LH-20	35.0 mg	21.0 mg
PHARMACOAT-606		14.0 mg
Total	700.0 mg	700.0 mg
Water content during kneading	25.7 %	20.0 %

Table 10: Granule characteristics

	A	B
Granulation velocity	225 g/min	290 g/min
Granule strength	0.46 %	0.13 %
Disintegration time	100 ~ 110 sec	45 ~ 50 sec

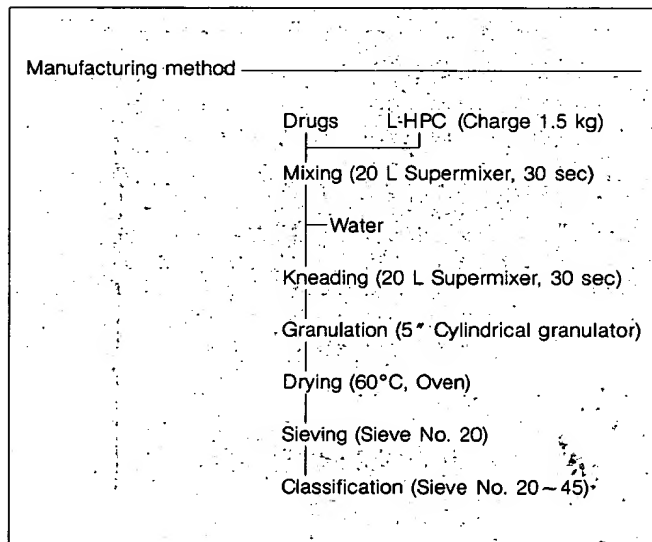
### ● Measurement

Granule strength: Roche friabilator

10 g, 25 min<sup>-1</sup>, 10 min

The rate in which powder passed through sieve No. 50 was calculated.

Disintegration time: Apparatus for USP disintegration test



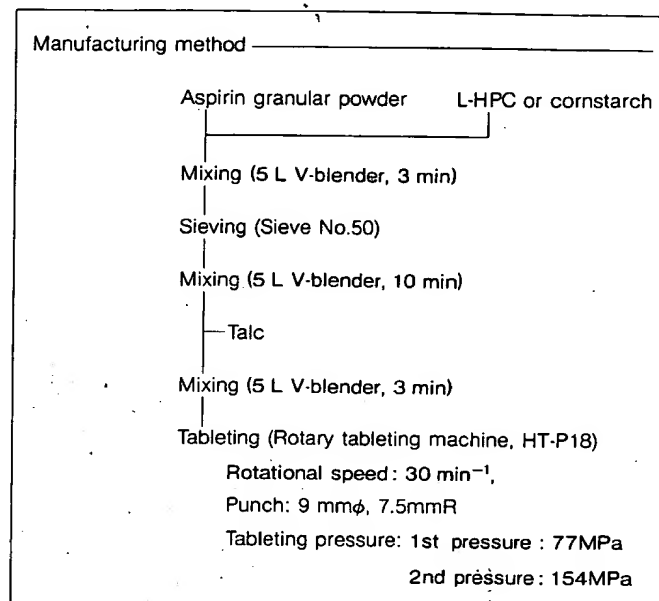
In every case, satisfactory granule properties were obtained. Although the addition of L-HPC alone is adequate, combination with a water-soluble binder further improves the properties.

### 3) Stability of aspirin tablets

In order to study the effect of L-HPC on the stability of drugs, L-HPC was used to prepare aspirin tablets. The salicylic acid content was investigated during storage tests.

Table 11. Tablet composition and initial tablet characteristics

		A	B
Composition	Aspirin granular powder	267 mg	267 mg
	LH-11	30 mg	...
	Cornstarch	...	30 mg
	Talc	3 mg	3 mg
	Total	300 mg/tablet	300 mg/tablet
Characteristics	Tablet hardness	12.3 kg	9.0 kg
	Disintegration time	1 min 26 sec	35 min 20 sec
	Friability	0.58 %	0.68 %
	Aspirin content	267.4 mg/tablet	268.5 mg/tablet
	Salicylic acid content	0.2 mg/tablet	0.2 mg/tablet



Measurement:

Tablet hardness: Monsanto hardness tester

Disintegration time: Apparatus for USP disintegration test

Friability rate: Roche friabilator, 20 tablets, 25 min<sup>-1</sup>, 4 min

Determination of aspirin and salicylic acid:

The contents were determined by spectrophotometry according to R.B. Tinker et al.

[J. Am. Pharm. Assoc., Sci Ed. 315 (1954)].

Table 12: Results of stability test

Storage conditions	Room temperature, Tightly stoppered, 6 months		40°C, 75% RH, One month	
	A	B	A	B
Tablet hardness	9.8 kg	10.3 kg	8.8 kg	11.8 kg
Disintegration time	1 min 15 sec	35 min 20 sec	1 min 20 sec	3 min 25 sec
Friability	0.72 %	0.95 %	0.96 %	1.06 %
Aspirin content	267.1 mg/tablet	268.0 mg/tablet	265.3 mg/tablet	266.1 mg/tablet
Salicylic acid content	0.4 mg/tablet	0.3 mg/tablet	0.9 mg/tablet	0.8 mg/tablet

L-HPC was found not to have any adverse effect upon the stability of aspirin.

## PACKAGING, SUGGETIONS FOR SELECTING TYPES OF L-HPC

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50kg net : double layered polyethylene bag in fiber drum

- 1 kg net : double layered polyethylene bag

Type	Usage	Purpose
LH-11	Tablets	Improvement in binding properties (prevention of capping) Improvement in disintegrating properties
LH-22	Tablets•Granules	Improvement in disintegrating and binding properties of preparations containing hydrophilic drugs
LH-21	Tablets•Granules	Improvement in disintegrating and binding properties of preparations containing hydrophobic drugs
LH-20	Granules	Improvement in granulating and disintegration properties
LH-32	Tablets•Granules	Improvement in disintegrating and binding properties of hydrophilic drugs
LH-31	Tablets•Granules	Improvement in disintegrating and binding properties of hydrophobic drugs
LH-30	Granules	Improvement in granulating and disintegrating properties

Careful work practice are important for the safe handling of this material. Read and understand the Material Safety Data Sheet before using L-HPC.

# PRECAUTIONS IN HANDLING

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## 1) Warning : May Form Flammable or Explosive Dust-Air Mixtures.

When handling in large quantities or in bulk, take precautions to avoid accumulation and suspension of dust in the air. Keep Away from Heat, Sparks and Flame. Do not Permit Grinding, Welding, Drilling or Smoking near this Material. General precautions outlined in the National Fire Protection Association's NFPA 63 "Prevention of Dust Explosions in Industrial Plants" and NFPA 654 "Standard for the Prevention of Dust Explosions in the Plastics Industry" are recommended.

## 2) Caution : May Cause Eye Irritation

Avoid contact with eyes, skin and clothing. Wash thoroughly after handling. Wash contaminated clothing before re-use. Use only with adequate exhaust ventilation. Follow an organized housekeeping plan. Keep floors and equipment clean.

## 3) Emergency and First Aid Procedures

If Ignited : Extinguish the fire with a common fire extinguisher.

If Inhaled : Remove the affected person to fresh air. Give artificial respiration if breathing stops. Get immediate medical attention. (A dust mask should be worn for handling a large quantity).

In Case of Eye Contact : Flush eyes with water for at least 15 minutes while holding eyelids open. Get immediate medical attention.

In Case of Skin Contact : Wash off with flowing water.

## 4) In Case of Material Spills and Leakage

The following steps should be taken.

- Wear an approved respirator, rubber gloves, rubber boots and safety goggles.
- Vacuum or sweep up spillage. Prevent dust generation. Place spillage in an appropriate container for waste disposal.
- Ventilate area and wash spill site.
- Wash contaminated clothing before re-use.

## 5) Storage

Keep dry. Store away from heat and sunlight. Store in sealed containers.

## 6) Disposal

Contents : Dispose of unused contents in accordance with all applicable Federal, State and local laws. Consult the distributor for further information.

Container : Do not re-use container. Dispose of empty container by the procedures approved by Federal, State and local authorities.

Carefully read and understand the Material Safety Data Sheet (MSDS) before using this product.

The information contained in this brochure does not constitute an express or implied warranty of quality. Any warranty of merchantability or fitness for a particular purpose is hereby disclaimed.

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